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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/684,714	10/14/2003	Chih-Huang Lai	RDRT 1004-2	4835

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EXAMINER	
KIM, PAUL D	

ART UNIT	PAPER NUMBER
3729	

DATE MAILED: 07/16/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

CS

Office Action Summary	Application No.	Applicant(s)	
	10/684,714	LAI ET AL.	
	Examiner	Art Unit	
	Paul D Kim	3729	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 June 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *23-28 and 31-49* is/are pending in the application.

4a) Of the above claim(s) *29 and 30* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *23-28 and 31-49* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *14 October 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *10/14/03*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

This office action is a response to the election of species filed on 6/23/04.

Response to the Election of Species

1. Applicant's election of Species A, claims 23-28 and 31-49, in the reply filed on 6/23/04 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

2. Claims 29 and 30 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on 6/23/04.

Specification

3. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The following title is suggested: --A METHOD OF FORMING A MAGNETORESISTIVE DEVICE--.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 34-49 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

As per claim 34 the phrase "said pinned layer" as recited in line 4 lacks antecedent basis.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 23-28 and 32-33 are rejected under 35 U.S.C. 102(b) as being anticipated by de Varies et al. (Exponential dependence of the interlayer exchange coupling on the spacer thickness in MBE-grown Fe/SiFe/Fe sandwiches).

Varies et al. teach the magneto-optical Kerr effect including a process of forming Fe/SiFe/Fe AFM layers. Inherently, the Fe/SiFe/Fe AFM layers could be formed on a substrate (see also attached document).

As per claim 24 Varies et al. teach that the AFM layer includes the use of molecule bean epitaxy (MBE) techniques.

As per claims 25 and 26 Varies et al. teach processes depositing a first iron (Fe) initial layer over the substrate, depositing a silicon (Si) layer over the first Fe layer and depositing a second Fe initial layer over the Si and heating the first Fe initial layer, the

Si layer, and the second Fe initial layer until material from at least one of the first Fe initial layer and the second Fe initial layer propagates into the Si layer to transform the Si layer into the FeSi layer (see page 3023 of the attached document).

As per claims 27 and 28 Varies et al. teach that the heating temperature is about 200 degrees C.

As per claims 32 and 33 the composition of the SiFe of Varies et al. is about 50:50 such as formed of $Si_{0.5}Fe_{0.5}$.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. Claims 23, 31, 34-37, 39 and 41-49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fontana et al. (US PAT. 5,701,223) in view of de Varies et al. (Exponential dependence of the interlayer exchange coupling on the spacer thickness in MBE-grown Fe/SiFe/Fe sandwiches).

Fontana et al. teach a process of forming a magnetoresistive sensor comprising steps of providing a substrate (45) and forming as AFM pinned layer (70) having a first magnetic layer (PF1) and second magnetic layer (PF2) separated by a non-magnetic material as shown in Fig. 5 (see also col. 6, line13 to col. 7,line 64).

However, Fontana et al. do not teach the AFM pinned layer with a first iron (Fe) layer and a second iron (Fe) layer separated by an iron-silicide (FeSi) layer. Varies et al. teach the magneto-optical Kerr effect including a process of forming Fe/SiFe/Fe AFM layers in order to optimize a strong antiferromagnetic coupling of the magnetoresistive sensor. Therefore, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to modify the AFM pinned layer of Fontana et al. by Fe/SiFe/Fe AFM layers as taught by Varies et al. in order to optimize a strong antiferromagnetic coupling of the magnetoresistive sensor.

As per claim 31 Fontana et al. also teach that the magnetizations between the first and second magnetic layers are antiparallel each other as shown in Fig. 5.

As per claim 34 Fontana et al. also teach that a spacer layer (65) is formed over the synthetic AFM layer and a free layer (63) is formed over the spacer layer and a pinning layer (57) is formed between the pinned layer (70) and the substrate (45) as shown in Fig. 5.

As per claim 35 Fontana et al. also teach that the spacer layer is formed of a non-magnetic metal, the free layer is formed of a ferromagnetic material, and the pinning layer is formed of an antiferromagnetic (AFM) material as shown in Fig. 5.

As per claim 36 Fontana et al. also teach that the spacer layer is formed of copper (Cu), the free layer is formed of NiFe, and the AFM layer is formed of NiO (also see col. 7, lines 45-54).

As per claim 37 Fontana et al. also teach that a first shield (55) is formed between the substrate and the AFM layer and a second shield (62) is formed over the free layer as shown in Fig. 5.

As per claim 39 Fontana et al. also teach that the spacer layer formed over the AFM layer is a layer of Cu.

As per claims 41 and 43 Fontana et al. also teach that the free layer is formed of NiFe.

As per claim 42 Fontana et al. also teach that the free layer is formed of CoFe (see also col. 8, lines 58-60).

As per claim 44 Fontana et al. also teach that the pinning layer is formed over the substrate prior to forming the AFM layer.

As per claims 45 and 46 Fontana et al. also teach that the AFM layer is formed of NiO.

As per claims 47-49 even though Fontana et al. do not teach the antiferromagnetic materials as recited in claims 47-49, the antiferromagnetic material of Fontana et al. is based on NiO material. At the time the invention was made, it would have been an obvious matter of design choice to a person of ordinary skill in the art to apply the antiferromagnetic material as recited in the claimed invention because Applicant has not disclosed that the antiferromagnetic material as recited in the claimed invention provides an advantage, is used for a particular purpose, or solves a stated problem. One of ordinary skill in the art, furthermore, would have expected Applicant's invention to perform equally well with Fontana et al. because the antiferromagnetic

material as recited in the claimed invention would perform equally well with Fontana et al. Therefore, it would have been an obvious matter of design choice to modify the antiferromagnetic material of Fontana et al. to obtain the invention as specified in claims 47-49.

10. Claims 38 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fontana et al. in view of de Varies et al., further in view of Pinarbasi et al. (US PAT. 6,315,839).

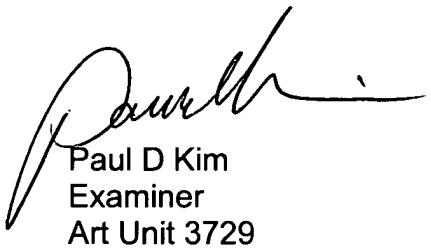
Fontana et al., modified by de Varies et al., teach all of the limitations as set forth above except a spacer layer made of copper between the second shield layer and the free layer. Pinarbasi et al. teach a process of forming a spin valve sensor including a second spacer layer (216) made of copper by sputtering between the second shield layer (218) and the free layer (F) as shown in Figs. 10 and 11 (also see col. 6, lines 35-40, col. 7,lines 7-10 and col. 8,lines 11-12). Therefore, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to modify the magnetoresistive sensor of Fontana et al., modified by de Varies et al, by a second spacer by sputtering as taught by Pinarbasi et al. in order to deposit the second spacer layer of the copper layer for the demagnetizing field of the keeper layer counterbalances or partially counterbalances the pinned layer demagnetization field. Also, it would be obvious to form the copper layer by sputtering in order to form the spacer layer in the presence of magnetic field.

Conclusion

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Paul D Kim whose telephone number is 703-308-8356. The examiner can normally be reached on Tuesday-Friday between 8:00 AM to 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Peter Vo can be reached on 703-308-1789. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Paul D Kim
Examiner
Art Unit 3729